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## THE BACTERIOLOGY OF INFLUENZA.\*

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The terms "influenza" and "grippe" were originally given to a communicable disease which spread over Europe in 1743, attacking chiefly the respiratory passages. Epidemics of an apparently similar nature continued to appear. The last pandemic began in Europe in 1889 and reached America in 1890. Direct bacteriological examinations of smears of the sputum showed the usual microorganisms met with in acute diseases of the respiratory passages and also abundant small bacilli. These, however, did not develop well on culture media and were not obtained in pure culture until two years later, when Pfeiffer discovered that they required hemoglobin for their development. Later it was found that growth took place without hemoglobin when in symbiosis with certain varieties of bacteria. The presence of these bacilli in pure culture in some cases of bronchopneumonia and otitis media and in enormous numbers in the mucus of many typical cases caused Pfeiffer to consider them the cause of the disease and the confirmatory findings of many others led to its universal recognition as the cause of the pandemics and of the smaller epidemics that continued to occur at intervals in Europe and America and also of endemic cases that had similar symptoms. The names influenza and grippe became restricted to a disease due to a small hemoglobophilic Gram negative bacillus and the similar epidemics of the past were considered as having been incited by this microorganism. The investigations carried on since then have cast doubt on the belief that all the great epidemics must have been due to the

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influenza bacillus. In fact, we are not absolutely sure that the epidemic of 1890 was due to it. This does not mean that there is any doubt as to the importance of the influenza bacillus in a great many of the inflammations of the respiratory tract as well as of other portions of the body. Recently, small epidemics affecting the respiratory tract have occurred in many countries and in many of these influenza bacilli have not appeared to be the causal organism.

The following findings emphasize this point: Jochmann, 1904, reported an examination of thirty-four cases diagnosed as influenza in which the bacillus was absent in more than half. Seligman in 1911 reported that a localized but rather widespread epidemic in Berlin was not due to the influenza bacillus, but probably to a pneumococcus. The epidemic of so called influenza which swept from the West to the East in this country a year ago was studied bacteriologically in many cities. It was especially widespread during November in Denver. Burdick did not discover influenza bacilli in any of his cases. A streptococcus seemed to be the cause. The epidemic reached Chicago in December. Moody found influenza bacilli in only two out of thirty-one cases. Mathers came to the same conclusion. In New York, Williams, in the Health Department laboratory, examined fifty cases with mild or severe influenza symptoms and found the bacilli in but nine. All the above mentioned observers found either the streptococcus, pneumococcus, or Micrococcus catarrhalis more prevalent than the influenza bacillus. It is very unfortunate that the bacteriologists did not have a knowledge of the prevalence of the influenza bacillus just before the 1889 epidemic and that Pfeiffer did not discover the bacillus at the beginning rather than at the end. All cases occurring in an epidemic must be due to the same organism. The outbreak of influenzalike cases in this country appeared to belong to an epidemic, and yet the bacteriological findings in different cities varied. Bacteriologists know that in infections of the upper

respiratory tract the microbe that starts an inflammation is frequently soon crowded out by other organisms, as, for instance, in whooping cough the Bordet's bacillus disappears within a week or two after the onset of symptoms, often leaving the influenza bacillus as the dominant organism. It is also true that the virulent organism is frequently found in small numbers compared to other bacteria, as in septic sore throat, where there may be only five to ten per cent. as many virulent streptococci as other streptococci.

Two possibilities present themselves in every epidemic. One is that an unknown virus, like the filterable virus of Kruse and Foster, or an ordinary microbe of unusual virulence, may pass from person to person in a condition which allows the slightly virulent influenza bacilli and pneumococci to develop, increase in virulence, and spread to other cases. The other possibility is that in some way a microbe of one of these ordinary types may increase in virulence, just as a meningococcus or the microbe of poliomyelitis does. There is no reason to believe that influenza bacilli were any less prevalent before the epidemic of 1889 than they have been since, for there was a pandemic in 1847 and a more localized one in 1875. We know from the finding of the Koch-Weeks bacillus, which is an influenza strain, or one at least of the hemoglobinophilic group, that these bacilli were prevalent before the epidemic in widely separated parts of the earth. The symptoms which were present in the epidemic of 1889 were sudden onset with frequently a chill, headache, muscular pains, and fever which was frequently high. Many began with a coryza and nearly all had a cough. The prostration was considerable. Our supposition is that most of these cases were in part or whole due to the influenza bacilli. The recent epidemic in which in many cases no influenza bacilli were present was characterized by similar but less severe symptoms—a coryza, sore throat, or



cough with severe headache, moderate fever, muscular pains, loss of appetite, and prostration.

From time to time during the past twenty years cases diagnosed as influenza and cases of disease in which influenza bacilli are apt to be present as mixed infection, such as tuberculosis and whooping-cough, have been examined. In every year they have been prevalent, but apparently they have lessened somewhat lately, especially in pulmonary tuberculosis. Thus, while Williams fifteen years ago found them present at Saranac Lake in twenty-five per cent. of the cases, Hamblet in 1915 found them in only seven per cent. of the open cases at Wallum Lake, R. I., and Garvin found them in a series of cases at Saranac recently in even a smaller percentage. In young infants the most complete reports are from the work of Doctor Wollstein at the Babies' Hospital. She found that as cold weather began, cases of respiratory trouble commenced to show here and there abundant influenza bacilli. The percentage increased up to midwinter and then it lessened, very few appearing after the middle of May. Holt reports the results as follows:

PERCENTAGE OF CASES HAVING INFLUENZA BACILLUS,  
PNEUMOCOCCUS, AND STREPTOCOCCUS.

	1909-1910	1911	1912	1913	1914
Bacillus influenzae .....	32	32	33	28	42
Pneumococcus .....	62	66	81	80	87
Streptococcus .....	33	37	46	43	29

In the examination of the mucus from large numbers of whooping cough cases during the past eighteen months Doctor Williams and her assistants in the Health Department found influenza bacilli in over fifty per cent. of the cases. These were present to some extent at all seasons of the year. During the past week we have examined forty-six cases to determine the prevalence of the influenza bacillus in various diseases. Our results were as follows:

Measles ..	10:	Influenza present, 8; pneumococci or streptococci, 10
Acute		
bronchitis	12:	Influenza present, 5; pneumococci or streptococci, 10
Pulmonary		
tubercul's	13:	Influenza present, 6; pneumococci or streptococci, 12
Diphtheria	10:	Influenza present, 3; pneumococci or streptococci, 8
Sinusitis .	1:	Influenza present, 3; pneumococci or streptococci, 8

During the past two months, sputums from fifty patients with lobar pneumonia have been tested and only in one have influenza bacilli been abundant. In this case no pneumococci were present. Many authorities believe that a diagnosis should only be made on culture. Thus Holt in a recent paper states: "By influenza we mean an inflammation due to Pfeiffer's bacillus." The prevalence of influenza bacilli, in many cases showing no symptoms, makes it difficult to consider all cases having the symptoms of influenza with the presence of influenza bacilli as being due to them. Another difficulty in making the bacteriological diagnosis is that we believe that there may be strains of hemoglobinophilic bacilli which are really quite distinct, even though they resemble each other very closely. Wollstein brought out the difference in virulence in rabbits, the meningitis strains being almost always virulent, while respiratory strains were not. The bacilli found in meningitis, otitis, trachoma, pink eye, and abscesses may or may not be the same as those causing respiratory infections.

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